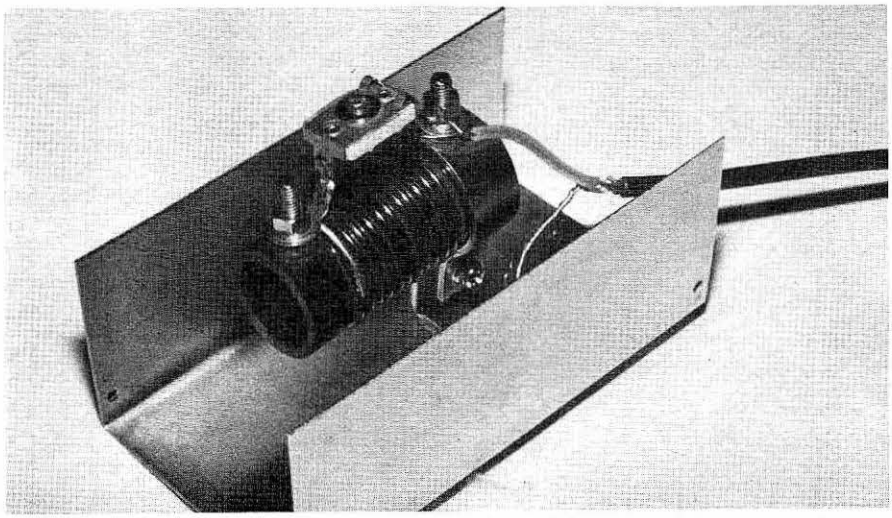
Fight Intermod Distortion With This LC Trap

by J. Alex Holmes

From time to time, SCAN members have asked us to devise some simple ways to combat intermodulation distortion. Beginning this issue, J. Alex Holmes will show you some easy and fun projects to construct that may help you to get rid of intermodulation distortion forever.



A tuned LC network is a relatively simple and inexpensive way to eliminate intermodulation distortion on your scanner.

If you live near a high-powered transmitter or are in a high RF environment, you may have experienced intermodulation distortion. For instance, have you ever been tuned to a favorite frequency when suddenly, without warning, another much stronger signal drowns out what you are monitoring? The reason for this may be that incoming signals are overloading your scanner's receiving circuitry.

There are two relatively simple and inexpensive ways to solve this problem. One of them, a tuned LC network, will be featured in this issue. Next time, I'll show you how to build a quarterwave shorting stub.

Tuned LC Network

Building a trap network, or a tuned LC network, is very simple. It consists primarily of a variable capacitor and coil. The two are used in parallel and the network is placed either at the antenna-coaxial cable feed point or just ahead of the scanner, itself. Although you can place them at either point, I prefer using mine near the scanner both for convenience and also for ease in retuning the circuit, if necessary.

The actual construction project is very easy and requires very few instruments, tools or parts. You'll need the following items:

- Two bulkhead coaxial connectors (SO-239s will do).
- A project box (be sure it has a removable top so you have access to the componentry).
- A piece of copper-clad board for grounding.
- A variable capacitor (between 50 and 250pF).
- Some standoffs.
- One coil.

Your tools should include a chassis punch for making the coaxial connector holes, and a drill for making holes when mounting pieces of the project to the board.

Instrument-wise, all that is needed is a grid dip meter for tuning the unit.

Construction

Use a ⅝-inch punch to make holes in the project board. These are for the bulkhead coaxial connectors. If you don't have access to a punch, use a drill with an appropriate sized bit. When drilling, be sure to start with a smaller bit and work your way up to the right size. Take your time; drilling at too high a speed may distort the box.

Next, loosely mount the bulkhead connectors and line up the screw holes. Punch out the screw holes and mount four screws and nuts. Don't tighten anything yet because you'll need to use one of the screws to mount a solder lug for ground later on. (This will enable you to maintain the coaxial cable's ground continuity throughout the project and it is the reason for using a copper-clad board.) Once this is finished, solder a piece of wire to the lugs.

With these steps complete, you're ready to assemble the LC network. This task is simply a matter of connecting the variable capacitor to the coil. You'll need to experiment to find the correct value of the capacitor. To make the project as simple as possible, try to purchase a capacitor that has leads on it. All that is left from here is to mount a pair of threaded brass standoffs to the loops, and then install the capacitor and the appropriate screws.

For experimentation purposes, I suggest assembling the LC filter with clip leads outside the project box. Clip one of the coil leads to one side of the capacitor and the remaining lead to the other.

Now, use the grid dip meter to tune the coil. Consult your instructions that come with the meter to locate the correct spot for tuning a coil. Begin tuning the capacitor and watch for the needle on the meter to dip. When the needle drops at the frequency you want to tune out, you've achieved your objective, and the network should effectively absorb or attenuate much of the bothersome signal.

If the first capacitor doesn't work, keep experimenting with other capacitors of different values until you find one that does. You may want to try a large air variable capacitor for expanded tuning range. These can be found in most old radios or you may be able to locate them at any of the surplus houses listed in electronics magazines.

Once the tuning is accomplished, mount the coil inside the project box (remember, the bulkhead connectors are already attached). Take the piece of copper-clad board and attach the LC network. Use standoffs to keep the network above the board (this will also serve as part of the ground

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AUX terminals. Make a note of the correct sequence.
4. Plug in the scanner and turn it on. Activate the AUX control. This is done by pressing ./AUX then E on the Bearcat scanners. Program an active local channel. (The National Weather Service on 162.55 MHz broadcasts continuously and is ideal for setting up the record function.)
5. Adjust the volume level on the scanner for the correct level. You may have to experiment with this to obtain hum-free distortionless recordings. The "twelve-o'clock" position is about right on my BC-250 and most recorders. The auxiliary input on some recorders occasionally provides better recordings.

This setup will record any signal received on a channel programmed for auxiliary control. To playback your tape you must unplug the control cable from the recorder.

Whenever I'm not able to monitor, I like to record a couple of channels. Trying to sort out bits of conversation on 30 or 40 channels is very difficult when the tape is played back. The paramedic channels are good candidates for recording. A real-life human drama is then available on cassette. Try recording one or two channels used by local broadcasters and you'll discover the important news that occurred while you were asleep or at work. If the base units use a separate frequency from the mobiles, set them up on adjacent channels so as not to miss any of the activity.

To operate the recorder, plug one end of the audio cable into the TAPE OUT jack on the scanner.

Once you get the hang of properly using a tape recorder with your scanner, you can really add a new and exciting dimension to your listening. Your tapes will provide you with a permanent record of your most interesting broadcasts. Best of all, you can relive the excitement simply by replaying the tape! If you have anything to add to this subject, write to us at SCAN Magazine. We'd be happy to share your experiences! SCAN

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SCAN BOOSTER

Intermod Filters

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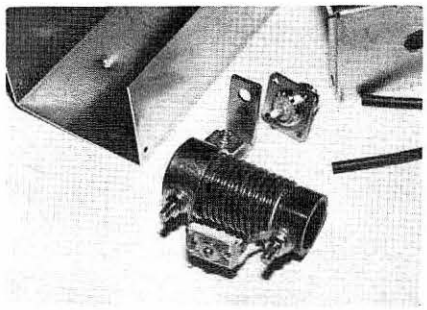
system). Measure the distance between the mounting leads on both the capacitor and the coil and then punch the hole with the proper-sized drill bit. Mount the standoffs to the board. Then, attach both the coil and capacitor, and attach two solder lugs to the standoffs carrying the coil.

With this installation on the board complete, drill the holes in the board for mounting standoffs. Inside the project box, install standoffs and mount the board. All that's left to complete the Tuned LC Network is a little soldering. Remember the ground wire that was left hanging from the bulkhead coax connectors? Find a convenient spot on the board and solder the wire in place. You'll need to solder it at both ends to ensure ground continuity.

Take another length of wire and solder it to the center pin of the bulkhead connector and then to the solder lug on the coil. Repeat this step on the other side of the project box and you're done. After this, put it in line with a short jumper to the scanner and connect the other side to the antenna. Wait until a signal comes up on the unwanted frequency and finish fine-tuning the trap.



The tuned LC network requires a coil, a variable capacitor, a project box, and two bulkhead coaxial connectors.

If you've done everything according to directions, close up the box and enjoy your scanner. Your intermodulation problems should be over.

(Next issue: How to build a quarterwave shorting stub.) SCAN

More Ways to Fight Intermod Distortion

by J. Alex Holmes

Continuing our examination of ways to fight intermodulation distortion, *SCAN Magazine* in this issue looks at another effective way of blocking out or reducing unwanted interference—the Quarter-Wave Shorting Stub. The first technique for eliminating intermodulation distortion on your scanner—the Tuned LC Network—was described by J. Alex Holmes in the March/April, 1982, issue of *SCAN Magazine.*

QUARTER-WAVE SHORTING STUB

One way to block out unwanted signals, especially those you'll encounter if you live near a high-powered transmitter or in a high RF area, is adapted from amateur radio. Called a Quarterwave Shorting Stub, it matches a feedline to a transmit antenna. But it is useful in moderating unwanted signals and can be easily built. It involves no more than an extra piece of coaxial cable a quarter wavelength long (at the interfering frequency), and a "T" connector for coaxial plugs.

To begin with, you must determine the length of a quarter wavelength piece for the offending frequency. Here is an easy formula for this purpose:

$$\frac{\frac{984 \times \text{velocity factor}}{\text{frequency in MHz}}}{4}$$

This formula may look more formidable than it really is. If you don't know what the velocity factor is, for our purposes, it is the speed of the coax. If you use RG-58/U or RG-59/U antenna cable, the velocity factor is .66. Keep that in mind when calculating this formula.

Now, if the offending frequency is 158.970 MHz, and we want a quarter-wave attenuation stub, insert these figures:

$$\frac{\frac{984 \times .66}{158.970}}{4}$$

The answer is 1.021 feet.

Now that you've calculated the formula, cut a piece of RG-58/U antenna cable to the length of about 13 inches (slightly more than 1.02 feet because it's better to start with a longer piece than to have to add a short one). To attach this piece to a "T" connector, use a standard PL-259 plug connector. The other run of coax from the antenna should terminate in a SO-239 connector to allow it to connect with the male part of the "T." You will also need another coaxial jumper fitted with a PL-259 connector and a Motorola antenna connector to hook up with the antenna input on the scanner.

From the 13-inch section of coax, strip off about an inch of the outer covering; debraid the outer conductor and twist it into a pigtail. Then, strip off the inner dielectric covering and twist the pigtail and the inner conductor together. This shorts the quarter-wave stub.

Strip off approximately ½" of the covering from the other jumper cable (the one with the Motorola plug) to expose the outer conductor. Attach both the quarter-wave jumper and the cable with the Motorola plug to "T" connector and attach loosely the shorted end of the quarter-wave stub to the bared outer shield of the other cable.

To get the least interference from the offending signal, you must tune the stub. To do this, it is best to use a simple pin inserted through the outer braid directly to the inner conductor. The reason? It is simpler to move the pins up and down the cable until the interference is eliminated than to try to trim the exposed end of the shorting stub. If you trim away too much of the exposed end of the cable, it's hard to add extra length if you need it.

Listen for the offending signal and move the pins around. When you find the spot where the interference is weakest, mark and trim the shorted end. Then solder together the inner conductor and the pigtail shield.

Now, take the soldered end of the shorting stub and attach it to the remaining cable whose outer conductor you have bared. This requires tack soldering to the oth-

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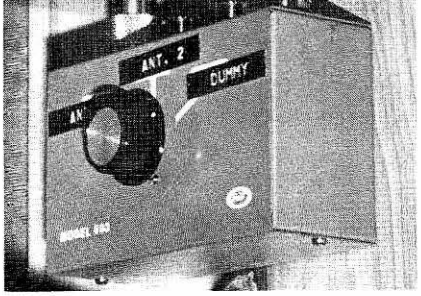
Behind The Scenes at KOAT-TV News

SCAN member John Lucero, news photographer with KOAT-TV in Albuquerque, New Mexico, is shown in the monitoring room of the station. Scanners include two Bearcat 210s, one Sonar FR-105, and 13 fixed crystal Motorola Alert monitors. These are fed into three Sky Ranger antennas tuned to the 150 MHz band. With this sophisticated setup, the station is able to monitor all important police, aircraft, military and federal frequencies in New Mexico . . . up to 200 miles away. John notes that the station was able to monitor all transmissions during the Columbia Space Shuttle's return to earth. If you have any photos of yourself at your monitoring post, either at home or at work, send them to us for inclusion in SCAN MAGAZINE!



If you have several antennas and scanners, an antenna switch makes a useful accessory.

allow you to listen at times which might disturb others in your home. Be sure the pair you choose is comfortable.

4) Tape recorder: Cassette and reel-to-reel are popular, but cassette players seem to be easier to obtain. See the March/April '82 issue of *SCAN Magazine* for a detailed article on hooking up a recorder to your scanner.

Of course, some other essentials include a pad or paper or log book, to help you keep track of calls and frequencies. For maximum aid in identifying unknown stations, a basic frequency guide such as the Betty Bearcat Director (and *SCAN Magazine*'s "Frequency Exchange") are musts.

Don't forget to have a good light source, such as a telescoping lamp, for evening operation. Stay away from fluorescent lamps, particularly if using shortwave gear. In addition, those persons who like to tune the shortwave and amateur bands may enjoy a 24-hour clock.

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SCAN BOOSTER CHARTER MEMBER

Here's the attractive listening post of SCAN member James Hunter, Logansport, Indiana. His gear includes a Bearcat 300 scanner, three Realistic shortwave receivers, a tape recorder, and an MFJ antenna tuner. When Jim is at work, he monitors the action on his Bearcat 4/6 hand-held scanner.

There are some available that not only display the time in local zones, but Greenwich Mean Time (GMT), as well.

If you take the time to set up your scanner listening station correctly, you find it will more than pay for itself in the hours of happy listening it provides. Again, for tips in setting up your post, check back issues of *Scanning Today* and *SCAN Magazine* for past "Photo Contest" winners. We've printed photos of some excellent set-ups. This issue contains some good ones, too! SCAN

Intermod Filters

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er cable. When done, wrap the area securely with non-conductive electrical tape to keep out such contaminants as dirt or dust.

Remember, either of these filters—the LC Network described in the March/April issue of *SCAN*—*or* the Quarterwave Shorting Stub described in this issue, will weaken the signals coming in through the antenna feed. The LC Network will effectively block out the signal, while the stub will act as a coaxial transformer for the offending signal.

If, after trying these two solutions, you still have an intermod problem, write to us. We'll forward your requests to our technical advisors for a second opinion. Good listening. SCAN

Notice

If you have an interesting story that is related to scanning, send it to us for publication in *SCAN Magazine*.